DOCUMENT RESUME

ED 324 485 CE 056 022

AUTHOR	Pollard, Jim
TITLE	Computer Aided Drafting Packages for Secondary Education. Edition 1. Apple II and Macintosh. A MicroSIFT Quarterly Report.
INSTITUTION	Northwest Regional Educational Lab., Portland, OR. Technology Program.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	Nov 87
CONTRACT	400-86-006
NOTE	29p.; For edition 2, a PC DOS version, see ED 292 988.
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Computer Assisted Design; *Computer Assisted Instruction; *Computer Software Evaluation; *Computer Software Reviews; Computer Software Selection; *Courseware; *Drafting; Industrial Arts; Microcomputers; Secondary Education; Teacher Attitudes
IDENTIFIERS	Apple II; Apple Macintosh

ABSTRACT

This report reviews software packages for Apple Macintosh and Apple II computers available to secondary schools to teach computer-aided drafting (CAD). Products for the report were gathered through reviews of CAD periodicals, computers in education periodicals, advertisements, and teacher recommendations. The first section lists the primary considerations in choosing a good CAD system, as agreed upon by teachers: cost, ease of use, ease of setup, and availability of coordinated curriculum materials. The following important features of CAD software are also outlined: dimensioning, display, creating objects, modifying objects, snaps, output, input, and modeling. CAD programs for Macintosh and Apple II series microcomputers are reviewed in separate sections. Each section begins with a brief discussion of advantages and disadvantages of the microcomputer and software available for it. A chart comparing the features of the CAD programs for specific microcomputers follows. Each program description includes publisher name, address, and telephone number; computer name; cost; and a summary of the opinions of the teachers who reviewed the program. Four programs for the Macintosh are reviewed: MacDraft, MGMStation, MiniCAD, and VersaCAD. Four programs for the Apple II are reviewed: MATC-CAD, discoverCAD, CADApple 2D Version 3.5, and Entry Level CADApple. (YLB)

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ED324485

THE Northwest Regional Educational Laboratory

TECHNOLOGY PROGRAM

COMPUTER AIDED DRAFTING PACKAGES FOR SECONDARY EDUCATION

EDITION 1

APPLE II AND MACINTOSH

A MicroSIFT Quarterly Report

November 1987

by

Jim Pollard

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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INTRODUCTION

The term CAD means "Computer Aided Drafting" (or sometimes "Computer Aided Design"). CAD is important in schools because it is important in the world outside of school. Virtually all design work in architecture, mechanical engineering, civil engineering and electrical engineering is done with a computer, with very little design currently done on the traditional drafting table. There are several reasons for the switch to CAD, among them are:

- Speed. An experienced user of a CAD system can produce a finished drawing in much less time than it would take an experienced drafter using manual tools.
- Ease of editing. Only the parts of a drawing which must be changed need to be redrawn in case of a change of plans or a new project which builds on an old one.
- Stored symbols. Much of drafting involves redrawing the same basic figures many times. In traditional drafting, specialized templates are available to make this redrawing easier. In CAD, a symbol library is used like these templates. A figure can be drawn once in great detail, stored in the library, called into the current drawing, and scaled to fit the rest of the drawing.
- Accuracy. Some CAD systems allow the drawing to be accurate to a tiny fraction of an inch. The computer can compute perfect ellipses, draw an exact tangent or draw a line at an angle which is precise to a fraction of a second.
- Less tedious. Some actions such as lettering and hatching are time-consuming and boring. With a computer lettering is as easy as typing and hatching can be done with a keystroke.
- Less manual skill. There are many potentially good drafters (and engineers and architects) who were discouraged from entering the profession because of their inability to draw a uniformly wide line or properly slanted letters.

THE SCOPE OF THIS REPORT

In this report we review several products which are available to secondary schools to teach Computer Aided Drafting. To gather the software packages for the report, we reviewed CAD periodicals, computer in education periodicals, advertisements, and recommendations of teachers. A product was considered for review if it was primarily for doing CAD or for teaching about it, if it ran on an Apple Macintosh, an Apple II or an MS-DOS compatible computer, and if the publisher of the software considered the package appropriate for secondary students.

After gathering the appropriate software, we searched for teachers who were currently teaching CAD to review the products from an educational perspective. We were surprised to learn how few teachers in the Northwest are currently teaching with CAD systems. Of these teachers few felt comfortable with the system they were using and fewer felt that they were qualified to evaluate other systems. Of those left, few had time to participate in the project.

In addition to the shortage of teachers who were available to review the software, there was a problem with finding school settings with the appropriate equipment. While some of the packages operate on standard Apple or IBM compatible computers, others require such additions as enhanced graphics adapter cards, math coprocessor chips, special input tablets or mice, special plotters, etc. Since these peripheral devices do not follow a standard protocol, the CAD software must have a way of communicating with the particular brand of peripheral that the school is using. These difficulties led us to separate the project into two reports: this report which discusses software for Apple Macintosh and Apple II computers and a future report which discusses software for IBM PC and compatible computers.

What features are important

In preparing to review the software for this report, teachers were asked what made a CAD system good in a secondary school setting. They agreed that the primary considerations were:

1. Cost of both the software and the hardware which hosts it
2. Ease of use
3. Ease of setup
4. The availability of coordinated curriculum materials

Several of the teachers stated that cost and ease of use were overwhelmingly important. If a system was rated high in those features, they could adapt their teaching to make up for any missing features in a CAD program. They agreed that a system which would be considered inadequate in a work setting could be acceptable in a secondary school drafting class.

In addition to the above criteria, there were several features which were considered important in CAD software:

Dimensioning--A program which does dimensioning will put the measurements of a drawing element (or object) on the drawing automatically. A program which does this well will draw witness lines (or extension lines), measure both linear dimensions and angular dimensions, calculate the areas of enclosed objects, and allow the student to decide on the placement, size and style of the numbers.

Display--The computer screen should have some basic information in front of the student. There should be an indication of the cursor's coordinates, a menu of choices available to the student, and a reasonably good drawing of the object which the student is completing. There should be different ways to view the drawing including the ability to magnify a portion (zoom in) and shrink the drawing to see more of it (zoom out). The student should be able to draw an object which does not fit entirely on the screen and to pan across different parts of it.

Creating objects--The essence of any CAD program is, of course, how well and easily it allows the student to draw diagrams.

Lines--There should be options to draw lines by connecting two points, drawing freehand, restricting the line to a particular angle, to creating a line parallel or perpendicular to another, and to creating a tangent to a circle or arc.

Circles--A student should be able to create a circle by specifying the center and radius or diameter, or by specifying three points on the circumference.

Ellipses--A good program will allow the creation of an ellipse by specifying the major and minor radii.

Arcs--The student should be able to construct both quarter and full arcs.

Spline curves or Bezier curves--These are curves which follow a series of separate points and would have been made using a french curve in manual drafting.

Hatching--The student should be able to hatch an area in a specified pattern.

Layers--In professional drafting, drawings are often constructed in layers which are like plastic overlays to the drawing. In architectural drafting, for example, the floor plan might be one layer, the electrical plan second, the plumbing a third, etc. A CAD system should allow the student to use several different layers.

Lettering--The student should be able to place lettering at any location and at any angle on the drawing. The size of the letters should be optional.

Grouping of objects--A group is an important entity in CAD systems. A collection of lines, curves, etc. may be a distinct unit or part in the total drawing. If this collection is grouped, it can then be moved, copied or otherwise modified as a unit.

Modifying drawings--Modifications to a diagram are necessary even during the completion of the drawing. A part which is drawn correctly but in the wrong place can be simply moved, rather than redrawn as in manual drafting. In cases such as creating gear teeth, the same part may be copied several times then moved or rotated into position. The most important modifications which should be allowed are:

Change scale

Move objects, groups, or text

Copy objects, groups, or text

Rotate objects, groups, or text

Snaps--Snaps allow the students to be more accurate in their drawings. With the snap feature on, when the student picks a location on the screen with the pointer, only certain points are possible. Most programs allow the student to define a grid and only points on the grid can be selected. For example, if the drawing will require line lengths in even quarters of an inch, the student would set a grid with quarter-inch increments. The program should have the option of turning the snap feature off for drawing parts which have dimensions not along the grid. Some programs also have a snap feature, "snap to objects," which positions the cursor on the line or curve nearest to the current location.

Output--A diagram from a CAD program is not useful while it is on the screen. There are a number of ways to produce the diagram in a useful form; among them are:

Plotter--A CAD program should allow the student to have a diagram printed using a plotter. There is no other standard output device in professional drafting. Plotters range in size (A through E) and the number of pens (and, therefore, colors) used. The more plotters which the program supports the better.

Laser Printer--While laser printers produce very good drawings, they tend to limit the size of the drawing to standard letter or legal sizes and to black-on-white diagrams. Because of these limitations, the students will not likely be using a laser printer in a professional drafting environment.

Dot matrix printer--This output is the least desirable and should be considered only if the cost of a plotter is completely unmanageable. Dot matrix output usually reflects the screen image with jagged lines instead of straight lines, circles and arcs with curves which are not round and text which is unreadable.

Export as a text file--An ideal CAD program will save the drawing in a form which can be read by other programs along the chain of CAD to CAM (Computer Aided Manufacturing). The programs include 3D modeling, finite element analysis and finally the tool path settings for such manufacturing devices as numerical control milling machines. There are standards for how a diagram is translated from one program to the next. Of these, the Initial Graphics Exchange Standard (IGES) and the Drawing Interchange File (DXF) are the most prevalent.

Input--A CAD program should allow the student to create a diagram using whichever input device is most appropriate for the job. More realistically, however, a secondary school is not likely to have more than one type of input device other than the computer keyboard. In fact, many teachers attempt to teach CAD using only keyboard input.

Graphics tablet--The software should allow input from a graphics (or digitizing) tablet. This is the standard form of input in the profession. Unfortunately, because the tablets are expensive and fragile, few schools have them. There is no standard for how the tablets interact with the computer so a CAD program must have drivers for a variety of tablets.

Mouse--Increasingly, school microcomputers are coming equipped with a mouse. This input device is standard with a Macintosh and an Apple IIgs microcomputer and an inexpensive option for an Apple IIe or IBM compatible microcomputer. Apple microcomputers tend to use a particular type of mouse so compatibility problems are rare.

Keyboard--Even if a tablet or mouse is being used, the program should allow the student to enter data through the keyboard. If, for example, a straight line between two points is called for, the best way to describe that line is through the coordinates of the two points. Virtually all text is entered through the keyboard regardless of the primary drawing tool.

Modeling--Some software will allow the student to take a two-dimensional drawing and create a three-dimensional model from it. Since modeling is rarely taught in secondary schools, this feature was not considered important by the drafting teachers.

CAD PROGRAMS FOR MACINTOSH MICROCOMPUTERS

Computer Assisted Drafting on the Macintosh is becoming more prevalent because of increased memory (one megabyte in RAM is now standard), disk drives with higher capacity, and a greater number of hard disk drives. While the number of CAD systems available does not approach the number available for IBM compatible hardware, the software which is available tends to be high quality and relatively inexpensive.

A Macintosh-based system may be appropriate for a school since the computer has both a high resolution screen and a mouse as standard equipment. Buying and installing CAD software is, therefore, much easier than with IBM compatibles with a confusing array of extra peripherals needed. In addition, the Macintosh operating system is very easy to use. Students should be able to master such tasks as running the CAD software, listing and copying files, and making backup copies of their drawings with little training.

There are two drawbacks to using the Macintosh for CAD instruction. The most immediate problem is the cost. The initial cost can be higher than that of IBM compatible equipment, but remember to add in the cost of the extra equipment you may need to run the IBM compatible software. The second drawback is in the relative dearth of software. Compared to the scores of titles available to IBM compatible computer users, there is relatively little software for the Macintosh. Making up for this is the fact that the software which is available tends to be quite good.

In the following pages we will present a comparison of the features of the CAD programs which we reviewed for the Macintosh. After this comparison there is a description of each program with a summary of the opinions of the teachers who reviewed the program.

A Comparison of Features for Macintosh Programs

	MacDraft	MGMStation	MiniCAD	VersaCAD
Computer	**512-SE**	**512-SE**	**512-II**	**Plus-II**
Version number	**1.2a**	**2.09**	**3.06**	**BetaII**
Minimum memory	**512K**	**512K**	**512K**	**1M**
Price①	**$239**	**$799**	**$495**	**$1995**
Scaling	✔	✔	✔	✔
Coordinates on screen	✔	✔	✔	✔
Relative coordinates	○	✔	✔	✔
Polar Coordinates	○	✔	○	✔
Zoom In	✔	✔	✔	✔
Zoom Out	✔	✔	✔	✔
Linear Dimensioning	②	✔	✔	✔
Angular Dimensioning	○	✔	✔	✔
Area Calculation	✔	✔	✔	✔
Witness lines	○	✔	✔	✔
Circles by Radius	✔	✔	✔	✔
Circles by 3 point	✔	✔	○	✔
Arcs by Radius	✔	✔	✔	✔
Arcs by 3 point	✔	✔	✔	✔
Bezier or spline curves	○	✔	○	✔
Hatching	✔	✔	✔	✔
Transfer to IGES	○	③	③	✔
Transfer to DXF	○	③	③	✔
Other transfer	PICT	PICT	PICT	○
Layers (Number)	1	40	16-40	250
Snap to Grid	✔	✔	✔	✔
Snap to Objects	○	✔	✔	✔
Trim lines	○	✔	✔	✔
Fillets	○	✔	✔	✔
Group by selecting	✔	✔	✔	✔
Group by fencing	✔	✔	✔	✔
Draw lines by coordinates	○	✔	✔	✔
Draw angles/arcs by coords	✔	✔	✔	✔
Move objects	✔	✔	✔	✔
Copy objects	✔	✔	✔	✔

①--Retail price. Educational discounts are usually available.
②--Not automatic ③--A program is available as an option

A Comparison of Features for Macintosh Programs (continued)

	MacDraft	MGMStation	MiniCAD	VersaCAD
Copy groups	✔	✔	✔	✔
Rotate groups	✔	✔	✔	✔
Rotate objects	✔	✔	✔	✔
Move groups	✔	✔	✔	✔
Rotate text	90°	○	90°	✔
Plotting	○	✔	✔	○
Laser Printer	✔	✔	✔	✔
Dot Matrix Printer	✔	✔	✔	✔
Draw with keyboard	○	✔	✔	✔
Draw with mouse	✔	✔	✔	✔
Draw with tablet/pad	○	○	○	○
3D	○	○	✔	○
Symbol Library	○	✔	✔	✔
Isometric drawing	○	○	○	✔
Tutorial	✔	✔	○	✔
Curriculum materials	○	○	○	○

Name: MacDraft

Publisher: Innovative Data Design
P.O. Box 27666
Concord, CA 94527-0666
Phone: 415/680-6818

Computer: Macintosh 512, Plus, SE

Cost: $239

MacDraft is the easiest of the drafting programs for the Macintosh that we reviewed. That it is also the least powerful may be unimportant to you. The teachers who helped review the software agreed that simplicity was an extremely important factor in rating a program for secondary schools. MacDraft is simple and intuitive enough that most students can begin using it immediately and produce something in their first experience with it. There is a clear tutorial with two exercises and the commands which are used follow the Macintosh standards. Students who have used any other program on the Macintosh will have no problem at all using MacDraft.

The use of the Macintosh interface is both a positive and a negative. The negative side is that the program has features which were popularized by painting and drawing programs rather than those of drafting. A strongly positive feature, for example, is the ability to create a dimension line. On the negative side is that the dimension line must be drawn by the student and the program does not provide witness lines to the object. As one teacher put it "if one is training students in real-world technology one needs to teach correct terminology."

MacDraft will perform all of the basic functions a first year drafting student might want to experiment with. Critically lacking in drafting tools is the inability to send output to a plotter and a symbol library function. Its best features are its cost and its ease of use. MacDraft would be ideal for introducing students to CAD in a setting where the teacher wanted to guarantee a successful first experience.

Name: MGMStation

Publisher: Micro CAD/CAM Inc.
3230 Overland Avenue
Los Angeles, CA 90034
Phone: 818/376-6860

Computer: Macintosh 512, Plus, SE

Cost: $799

MGMStation (for Micro Graphic Manufacturing Station) is a CAD package which is completely designed for the professional. Unlike other Macintosh products, the system is designed as much for keyboard input of data for drawing as it is for mouse input. Because of this, students who are familiar with other Macintosh products such as MacDraw or MacPaint may have difficulty getting accustomed to the program. On the other hand, a student who is very familiar with manual drafting will feel very comfortable. The program uses standard drafting terms and emulates manual drafting while adding the ease of a microcomputer.

The students will find that almost any drafting function that they have learned is available on the system. The choices of methods of completing any drawing element are comprehensive and even overwhelming at times. For example, a student who wants to draw a six-inch line will choose the line menu and have the following choices:

Line to absolute point
Line to relative point
Line in direction
Line to existing point
Parallel line
Parallel to existing point
Perpendicular line
Between two existing points
Polar increment line
Length modification
Line to point on the grid
Free line

Other drafting programs would assume that the student was drawing a free line or a line to a point on the grid. The other choices would either not exist or would require special action under a different menu.

The reviewers found that using MGMStation encouraged the students to plan their diagrams more carefully than with other systems. The

then connect those points with lines. The emphasis is on precise execution of a drawing rather than on experimenting with the drawing elements.

The only feature that the reviewer found lacking was a 3D modeling function which they would have found only marginally useful in secondary school, anyway. They found the system unnecessarily complex at times due to menus which were difficult to read and overly detailed. The screen on the Macintosh sometimes became cluttered with vestiges of lines which had been moved or deleted. While these could be eliminated by "repainting" the drawing, this step added to the students' difficulty with the program.

On the positive side, the reviewers liked the comprehensive choices which were available. In addition to the standard choices of lines and arcs, the student may construct fillets, rounds and chamfers, may trim or extend lines, and may rotate or mirror parts. The program's symbol library was considered important and well executed. Completed diagrams may be drawn on a variety of plotters as well as dot matrix or laser printers.

Name: MiniCAD

Publisher: Diehl Graphsoft Inc.
3246-K Normandy Woods Drive
Ellicott City, MD 21043
Phone: 301/461-9488

Computer: Macintosh 512, Plus, SE,II

Cost: $495

MiniCAD is a professional CAD package, the marketing of which tends toward architectural drafting, but it is well suited to mechanical or electrical drafting as well. The reviewers rated it moderately easy to learn. Basic drawing functions are quite easy to learn, especially if the student has experience with other Macintosh programs, but more complex features are more difficult to learn. The program allows drawings which include fillets, trims, line extensions and ellipses, with each function easily selected and executed. Drawing entities may be constructed using the mouse, or they may be entered in a "data box" in which the student describes the entity in terms of its length, its width, the start and arc angles (for full arcs) and the X and Y coordinates at which the entity is to be placed.

A key benefit of MiniCAD is its precision. The student may select what unit of measure a screen unit represents and choose to show the decimal accuracy of the measurements to nine places or 1/64th of a unit. The program's rotation function is very precise, allowing rotation angles to the nearest second.

The program handles drawing layers very nicely. The student may choose to hide layers which are not active, to show them, or to show them in gray lines. Switching between layers is simple through a menu selection. Symbols, groups, and objects are easily transferred between layers.

The program includes a symbol library function which is easy to use. In addition, there is a 3D modeling section which was judged very difficult to use. Drawings made in the 2D section may be transferred to the 3D section then changed into a 3D drawing, although the reviewers found this feature difficult to accomplish.

The greatest hindrance to classroom use of MiniCAD is in the lack of documentation and support materials. Instead of a nested series of menus such as MGMStation uses, MiniCAD uses menus in which the student must hold down the Command Key, the Option Key or Both when selecting an item to change what that menu item does. For example, choosing an ellipse from the drawing menu will draw an ellipse; holding down the shift key while selecting an ellipse will draw

a circle; double clicking the mouse on the ellipse instead of single clicking will bring the data box onto the screen for keyboard entry of the ellipse radii and coordinates. These features are difficult to use since there is no on-screen help.

The manual is poorly organized. It is arranged by where the feature discussed appears on the screen menus. Since this arrangement is not always what might be expected, the student must know the program well before being able to find a feature description in the manual. The index is not at all helpful.

The version of the program reviewed did not work as it should have at all times on the Macintosh Plus or SE. There were times when lines would appear randomly on the screen (especially after panning the window to another part of the drawing) and vestiges of lines which were deleted or moved often remained on the screen.

Overall, MiniCAD is a good program to teach CAD at the secondary school level because it is easy enough to learn that students can complete a simple drawing in their first experience. It has all of the features which make a CAD system useful in a professional setting and it employs drafting techniques and language.

Name: VersaCAD

Publisher: VersaCAD Corporation
7372 Prince Drive
Huntington Beach, CA 92647
Phone: 714/847-9960

Computer: Macintosh Plus, SE,II

Cost: $1995

VersaCAD on the IBM is considered one of the most powerful CAD systems available on a microcomputer. The publisher of that software is currently beta testing a similar program for the Macintosh. Since that program will likely be a popular choice for professionals, we decided to include a brief description of the program's features, including features which are promised but not fully functional in the test copy. This description should be used to compare other systems to a proposed "top of the line" system and not as an evaluation of a fully functioning product.

VersaCAD Macintosh Edition is surprisingly easy to use. Most of the choices for constructing or modifying a drawing are available as a menu selection from a series of palettes which appear on the screen. The student has control over how many of these palettes are shown, with the option of hiding ones which will not be used for a while in order to leave more work area for the drawing. Virtually every CAD feature (except 3D modeling) is available in VersaCAD. Each entity can be drawn in several different ways and input can always be by mouse, by absolute coordinate or by polar coordinate.

The program is also precise. Linear dimensions can be shown to 16 decimal places. Students have access to a number of tools, including the ability to confine the slope of a line which they draw to an exact angle; the ability to construct fillets between lines, circles and arcs; trim lines in several ways; draw double lines with a variety of end caps; construct tangents to circles and arcs; and automatically create isometric drawings.

CAD PROGRAMS FOR APPLE II SERIES MICROCOMPUTERS

The Apple II is the most prevalent microcomputer system in U.S. schools. Since drafting departments usually need to share microcomputer resources with other departments, CAD systems which operate on an Apple II are worth investigating. This option is especially attractive since this microcomputer is often located in a laboratory setting where the drafting teacher can instruct a whole class at once.

The Apple II is not a computer which is used widely in professional CAD applications. The intent of most of the programs reviewed here is to teach about CAD and to introduce concepts. The programs succeed in that goal to varying degrees.

Before deciding whether an Apple II system would be adequate for a school, the goals of the drafting program should be decided. A goal which involves familiarizing the student with the types of things that a microcomputer CAD system can do can be met by an Apple II based system. A program which seeks to train the student in the software that he or she will use in an entry level job after graduation will probably need to investigate a Macintosh or IBM compatible system.

In the following pages we will present a comparison of the features of the CAD programs which we reviewed for the Apple II. After this comparison there is a description of each program with a summary of the opinions of the teachers who reviewed the program.

A Comparison of Features for Apple II Programs

	MATC-CAD	discoverCAD	CADApple	Entry Level
Computer	**II+,e,c**	**IIe, IIc**	**IIe, IIc**	**II+, IIe, IIc**
Version number	**4.2**		**3.5 (1)**	**1.0**
Minimum memory	**64K**		**128K**	**64K**
Price	**$500**	**$239.95**	**$1495.00**	**$99.00**
Scaling	①	O	✔	✔
Coordinates on screen	O	O	✔	✔
Relative coordinates	O	O	✔	✔
Polar Coordinates	O	O	✔	✔
Zoom In	✔	✔	✔	✔
Zoom Out	✔	✔	✔	✔
Linear Dimensioning	✔	✔	✔	✔
Angular Dimensioning	✔	O	✔	O
Area Calculation	✔	O	O	O
Witness lines	✔	✔	✔	✔
Circles by Radius	✔	✔	✔	✔
Circles by 3 point	✔	✔	O	O
Arcs by Radius	✔	✔	✔	✔
Arcs by 3 point	✔	✔	✔	✔
Bezier or spline curves	✔	O	✔	O
Hatching	O	O	✔	O
Transfer to IGES	O	O	O	O
Transfer to DXF	O	O	O	O
Other transfer	O	O	O	O
Layers (Number)	256	128	250	10
Snap to Grid	✔	✔	✔	✔
Snap to Objects	O	O	O	O
Trim lines	✔	O	O	O
Fillets	✔	O	✔	O
Group by selecting	O	O	✔	✔
Group by fencing	O	✔	✔	✔
Draw lines by coordinates	✔	O	✔	✔
Draw angles/arcs by coords	✔	O	✔	✔
Move objects	✔	✔	✔	✔
Copy objects	✔	✔	✔	✔

①--There are no units associated with scale.

A Comparison of Features for Apple II Programs (continued)

	MATC-CAD	discoverCAD	CADApple	Entry Level
Rotate objects	✔	✔	✔	✔
Move groups	○	○	✔	✔
Copy groups	○	✔	✔	✔
Rotate groups	○	✔	✔	✔
Rotate text	✔	○	✔	✔
Plotting	✔	✔	✔	✔
Laser Printer	○	○	○	○
Dot Matrix Printer	✔	✔	✔	✔
Draw with keyboard	✔	✔	✔	✔
Draw with mouse	✔	✔	✔	✔
Draw with tablet/pad	✔	○	✔	✔
3D	○	○	○	○
Symbol Library	①	○	✔	○
Isometric drawing	○	○	○	○
Tutorial	✔	✔	✔	✔
Curriculum materials	✔	○	○	✔

①--Parts of a drawing can be saved and merged with other parts.

Name: MATC-CAD

Publisher: Milwaukee Area Technical College
1015 North 6th Street
Milwaukee, WI 53203

Computer: Apple II+, IIe, IIc

Cost: $500.00

What sets MATC-CAD apart from other microcomputer CAD systems is that this program is designed to teach more than to be an actual CAD tool. Moreover, the program is designed to teach how to use a mainframe computer for drafting. While using microcomputers for drafting is the most visible new trend in CAD, there are thousands of professionals who use CAD systems on mainframe and minicomputers. Specifically, the package teaches how to use the Computervison Corporation's CADDS3 system.

As a teaching program, the strengths of MATC-CAD are those which make it suitable to the classroom. These benefits include:

There is a comprehensive student's manual with guided lessons, exercises and quizzes.

There is a teacher's with explanations of the lessons, answer keys, tips on using the software, and troubleshooting tips.

The program comes on one disk and can be used on a Corvus hard disk system.

There is a good "quick reference chart" to remind students of the commands.

The program works with an Apple II+ as well as newer Apple microcomputers.

MATC-CAD had strengths as a CAD system as well. All of the options for drawing lines, angles, circles, arcs, fillets, etc. are available to the student. This is particularly good in a system where the purpose is to teach about CAD. The main features of a CAD program which are missing are hatching and the ability to operate on groups of objects.

The program's drawbacks are primarily reflections of the drawbacks of the system which it emulates. The command structure is cumbersome, with many commands requiring several abbreviated words before executing. For example, inputing a horizontal line would require the command **INS LIN HOR :** before using the mouse or the graphics tablet to input the coordinates of the line. While this is, of course, much easier and more flexible than drawing the line manually.

it is not as easy as students are likely to find using more modern microcomputer CAD systems.

Measurements and coordinates are weak spots in MATC-CAD. There is not a function to allow students to select the units they are working in, so, for example, a "1.345" on the screen could represent feet, miles, etc. Neither the coordinates of the cursor nor points on the grid are labeled, so the student may often be working with no idea where the object being drawn is in relation to other objects.

In general, the reviewers called MATC-CAD very difficult to use. The on-screen menus which appear when the mouse is used are as difficult to decipher as the actual keyboard entries. One reviewer noted that since the students did not get immediate success or feedback they became bored. While the program is sometimes slow to operate, accessing the disk often and redrawing slowly, the reviewers did not see this as a major obstacle. The manual was difficult for some students.

Name: discoverCAD

Publisher: Hearlihy & Co.
714 W. Columbia St.
P. O. Box 869
Springfield, OH 45501
Phone: 513/324-5721

Computer: Apple IIe, IIc

Cost: $239.95

The major features that the teachers interviewed look for are ease of use and cost of a CAD program. Using only these criteria, discoverCAD should be considered. It is designed for secondary school use, with on-screen menus and simple operating commands. Students can use the program to make simple drawings using lines, circles and arcs. They may add text and have lines and circles automatically dimensioned. The screen is attractively displayed and the objects are drawn as well as they can be rendered on the high resolution Apple screen.

The program was missing some features which are important in teaching CAD in the secondary school. The coordinates of the cursor, the location of the origin and the grid increments are never displayed. The students cannot even enter the absolute length of a line which they are drawing. These shortcomings require the student to display the grid and to count the dots as they draw a line or specify a radius to a circle. Virtually any action requires this dot counting and is not only tiring, but poor training in the use of a CAD system.

While the program has a zoom feature, there is no way to specify the part of the drawing which should be displayed in greater detail. Since the zoom displays the center of the original drawing, the screen must be panned to where the part of the drawing of interest is centered then zoomed. These actions required over a minute to complete in a drawing with only four objects.

The program provides no feedback when menu selections are made. If a student selects a menu item then points to an inappropriate part of the screen, the program does nothing. Since actions such as rotating an object require up to four mouse clicks, the student must have the manual open to the correct page at all times. The manual itself is difficult to read.

While the reviews rated discoverCAD very easy to use, they found that the lack of important features and the slow and awkward way of drawing with the program would be a problem in a classroom. One reviewer suggested that the program might be appropriate for the teacher to use in demonstrating the principles of CAD in a middle school setting.

Name: CADApple 2D Version 3.5

Publisher: VersaCAD Corporation
7372 Prince Drive
Huntington Beach, CA 92647
Phone: 714/847-9960

Computer: Apple IIe, IIc

Cost: $1495.00

CADApple is designed as a professional CAD system for use on the Apple IIe or IIc. It uses the standard Apple high resolution graphics (280 x 192 pixels) and input from joysticks, mouse or tablet. The program is similar to the company's VersaCAD product, with menus and commands upwardly compatible to that product. Because of the low resolution, curves are not represented smoothly on the screen and lines which are not horizontal or vertical are jagged.

The program has some very powerful features. It will dimension lines and angles and will allow the student to place the dimension lines and text anywhere in the drawing. The student may choose the line styles and hatching patterns. Fillets can be drawn between any two lines, two arcs, or a line and an arc. Groups of objects may be saved in a library and added to any drawing as symbols.

Students may draw virtually any object on the screen. The real-world coordinates of the cursor are always on screen and there is a reminder when the origin is shifted. The zooms are relatively fast and the student may specify a particular part of the drawing to magnify. Complete information on any object--including the X and Y coordinates, the linear and angular dimensions and a measure of rectangular areas--is available at all times.

The program handles groups well. Objects may be assigned to a group directly using the mouse to select them, or they may be assigned on the basis of common characteristics. Once a group is defined it may be modified in any way as a whole.

Text can be placed anywhere in the drawing and at any angle. The student may determine the height and width of the text. Line styles, line densities, and plotter pens can all be selected and modified.

The manual is well written and contains a tutorial. There are context-sensitive help screens available for any menu item.

The package is moderately easy to use. The options are clear in the menu, but the menu and the drawing are not on the screen at the same time. While creating a drawing it is possible to have the program

waiting for an answer to a question which is not visible to the student. Other features such as remembering default settings, auto-dimensioning, and fillets make this a very nice package. This system is very much like professional microcomputer-based CAD systems and, as such, would be valuable in preparing a student for an entry level position.

Name: Entry Level CADApple

Publisher: VersaCAD Corporation
7372 Prince Drive
Huntington Beach, CA 92647
Phone: 714/847-9960

Computer: Apple IIe, IIc

Cost: $99.00

Entry Level CADApple operates in much the same way that CADApple 3.5 does. It uses the standard Apple high resolution graphics (280 x 192 pixels) and input from joysticks, mouse or tablet. Because of the low resolution, curves are not represented smoothly on the screen and lines which are not horizontal or vertical are jagged.

The program has some very powerful features. It will dimension lines and angles and will allow the student to place the dimension lines and text anywhere in the drawing. The student may choose the line styles, plotter pens, and up to ten drawing layers.

Students may draw virtually any object on the screen. The real-world coordinates of the cursor are always on screen. The program handles groups well. Objects may be assigned to a group directly using the mouse to select them, or they may be assigned on the basis of common characteristics. Once a group is defined it may be modified in any way as a whole.

The manual is well written and contains a tutorial. In addition, there is a book of self-paced sequential tutorials which explain the principles, concepts and uses of CAD as well as how to use the Entry Level CADApple program.

The package is moderately easy to use. The options are clear in the menu, but the menu and the drawing are not on the screen at the same time. While creating a drawing it is possible to have the program waiting for an answer to a question which is not visible to the student.

The reviewers liked the program for its ease of use, similarity to professional CAD systems, and very low cost. None felt that a program would be seriously hampered if this were the only CAD system which was taught in a secondary school.

RECOMMENDATIONS

The most important recommendation that we can offer is that if your secondary school is not teaching about Computer Aided Drafting, it should be. The profession of drafting has changed but very few secondary school programs have changed with it. While students will learn the concepts of drafting in a class on manual drafting, the manual skills they learn are not the ones they will be using.

The best way to teach CAD depends on your resources and your goals. You can start to teach CAD to your secondary students using the Apple II equipment already at the school. Ideally, the computers would be in a lab setting. Adding a mouse to the computers in the lab and equipping each with a copy of Entry Level CAD is the least expensive alternative and, as this project discovered, it is an adequate alternative. Entry Level CAD contains most of the features of professional systems, it is compatible with similar systems on the IBM and the Macintosh, it is easy to use, it already has a curriculum developed, and it is very inexpensive.

Using a Macintosh with a plotter and a digitizing tablet will introduce the students to CAD as they will likely experience it in a professional setting. This solution is expensive, but may be worth the investment if there are entry level jobs in your community in which the students would use similar systems. If this is your choice, then the program which is most likely to be helpful to the student is MGMStation. It operates like most professional systems, it has most of the CAD features used professionally and it is currently the most widely used by professionals. Any of the other programs reviewed for the Macintosh would be a good alternative for teaching basic concepts.

If your community has entry level jobs in a market where mainframe computers are common, then MATC-CAD for the Apple II would be an appropriate program to investigate. It is not as easy to use as many, but it has most of the features of professional systems, it has a built-in curriculum, and it emulates the Computervision mainframe system exactly.